

Evaluation of the Impacts of the Macrodrainage Works of the Tucunduba River: Case Study of the Community of Pantanal - Belém, Brazil.

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Abstract—This research investigates the social and sanitary situation of the Pantanal community located in the city of Belém, Pará. The methodology used sought to identify, in a quantitative and qualitative way, the positive and negative impacts of the macro drainage works of the Tucunduba watershed. Data collection was carried out by means of a semistructured questionnaire with an evaluation character, with the purpose of performing a Socioeconomic and Environmental Regressive Analysis (SEA), making a comparison before and after the beginning of the works. The result shows a social and sanitary improvement of the community, however there are caveats regarding changes in the execution and delays in the works that generated several disorders to the community.

Keywords—Environmental sanitation, Hydrographic basin, Macrodrain.

I. INTRODUCTION

Throughout the process of urban occupation of the city of Belém, areas of flooded land were occupied by an impoverished population that found in these lands, economically devalued, a housing solution near the main nucleus of the city (PENTEADO, 1968). These are floodplain or floodplain areas known as "plains," officially used by the government in the 1970s to designate irregular and poor occupations.

The main strategies for intervention in lowlands carried out by public authorities have been through macrodrainage projects with the objective of reorganizing and integrating

these areas in the "formal" city and that would allow the expansion of infrastructure for the real estate market (ABELÉM, 1980). In this context, there is the macro drainage project of the Tucunduba stream that aims to interrupt the flood and structure the area.

Based on these meanings, this article aimed to investigate the socioeconomic and sanitary situation of the pantaneiro complex located on the banks of the Tucunduba river and to identify the positive and negative impacts of macrodrainage work, making a comparison since the beginning of the first interventions for the year 2018, based on Socioeconomic and Environmental Regressive Analysis (SEA).

II. MATERIAL AND METHOD

The research consisted of a mixed, qualitative and quantitative research approach, through bibliographical and field research. Regarding the objectives, the research was descriptive and evaluative, since it was intended to describe and evaluate the environment in transformation in recent years, giving special attention to community health issues and to the positive and negative changes during the Tucunduba macrodrainage works.

In the field surveys, different data collection instruments were used, based on in situ observations, informal conversations, image capture and application of a questionnaire to residents of the Pantanal community in Belém - PA, on November 10, 2018.

The semi-structured questionnaire was constructed with the objective of performing a Socioeconomic and

Environmental Regression Analysis (SEA) on the positive and negative impacts of the Tucunduba macrodrainage work. As a reference, the period used for the regression analysis of the SEA was 20 years, between 1998 and 2018, since it comprises the period of time in which the project was implemented.

The evaluation instrument worked in four dimensions: socioeconomic, basic sanitation conditions, macrodrainage impacts and vision of the future. Each attribute was evaluated by the following scores: 01 (very low); 02 (low); 03 (average); 04 (high); and 05 (very high), making a comparison between the period analyzed above. After assigning the scores on the different attributes, calculations were made to measure the indices of advancement and/or regression of each dimension, in order to perform the Regressive Analysis. The calculation of the indices was performed by the sum of the scores assigned to each attribute, divided by the sum total of the scores 05 (very high), ie $i = e1 / 5 + e2 / 5 + e3 / 5 + \dots$. Thus, the calculated indices could go from zero to one (0-1), and the closer to

one (1), the better the index, so the better the dimension was evaluated. On the other hand, the closer to zero (0), the worse the index, the less well evaluated was the dimension. The resulting indices allowed for quantitative assessments, in each dimension, if there were advances or setbacks.

Historical contextualization of the tucundubamacrodrenage project

The Tucunduba Basin covers the neighborhoods (University, Terra Firme, Guamá, Canudos and Marco) of three Administrative Districts (DAGUA, DABEL and DAENT). It has an approximate population of 161,499 inhabitants. Historically, the occupation process has advanced on the institutional areas belonging to the Union (UFPA, FCAP, EMBRAPA, Emílio Goeldi Museum). In these areas, occupations were carried out by low-income population. All of them were marked by urban land conflicts centered on the struggles for the right to housing, intensified mainly in the 1980s, over river beds.

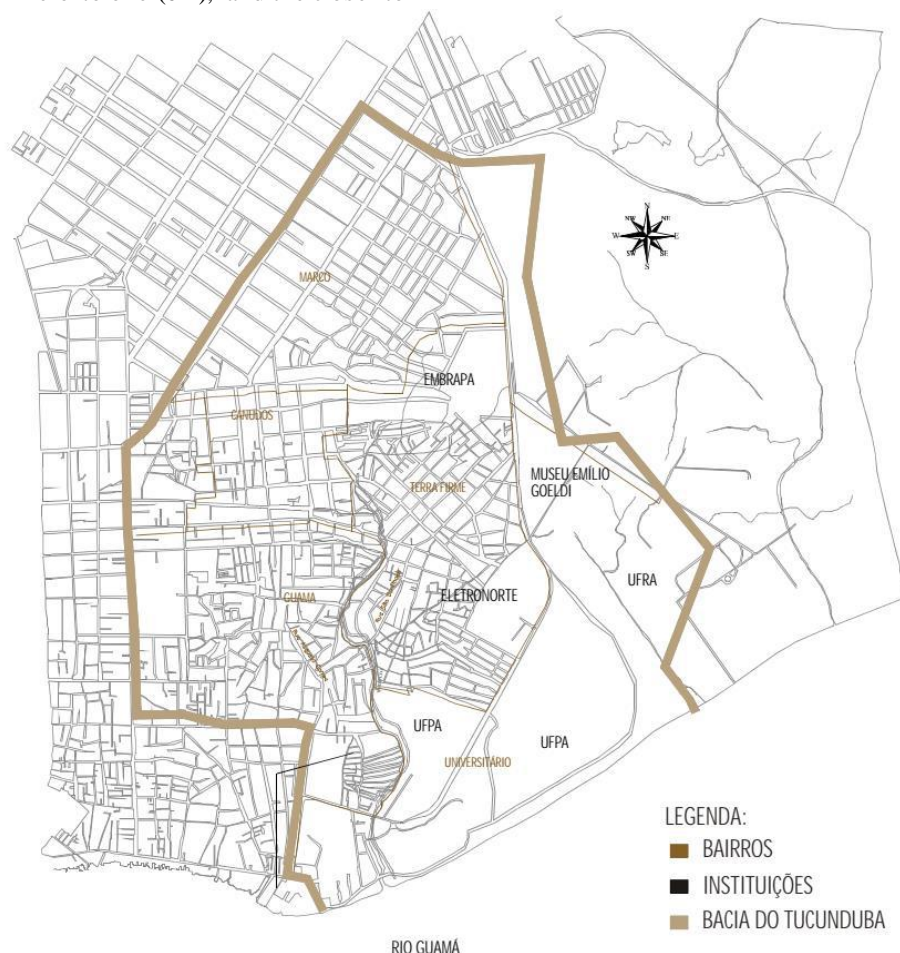


Fig 1. basin of the Tucunduba River.

It is an area historically occupied by "stilt houses" constructed in waterways, where basic sanitation services do not exist or are insufficient. The situation of poverty is characterized by unemployment, underemployment, high

levels of violence and crime, and is therefore responsible for the creation of an urban environment of low sustainability, compromising living conditions that make socioeconomic inclusion unfeasible.

In these areas, the first actions were carried out by the residents themselves, opening streets, landing with wood sawdust and açai stones, but this was insufficient to solve the problems of floods and floods. Faced with these difficulties, the popular neighborhood movements were consolidated, which began to denounce the precarious conditions of life in these urban spaces. Among these popular movements is the community of Pantanal, consolidated in the area since the beginning of the occupations.

The first drainage works in the basin began in 1993, with the macro drainage of the canals of the Angustura, Leal Martins, Timbó and Vileta junctions in Marco neighborhood. However, these interventions were timely and were being carried out according to the availability of funding.

In 1998, after the re-evaluation of the projects, the Tucunduba Project was developed, involving partnerships between the Federal Savings Bank, the Federal University of Pará, nongovernmental entities and leaders representing the interests of the population residing in the area. The general objective of the project is to "revitalize flooded areas of the Tucunduba Basin through: physical and environmental interventions, social inclusion of residents, generation of work and income, encouraging the permanence in the place, and creating management participatory in the maintenance of the public good" (PMB, 1999, p.3).

The Tucunduba Project appears as a proposal for urban intervention based on local economic development and urban environmental management, prioritizing the recovery of degraded areas, located in the outskirts of the city of Belém (BARBOSA, 2003). This project is part of the Program "Management of Urban Rivers: City of Belém dos Rios". Initially, the project was financed with 73% of the FGTS loan proceeds, managed by the FGTS Curator Council and CAIXA, with a counterpart of 27% of PMB's own resources.

Every two years, CAIXA promotes the choice of 20 Best Practices in Local Management, articulated with the "Best Practices and Local Leadership Program" (BLP), conducted by UNCHS / HABITAT. In 2001, the Tucunduba Project was one of the practices awarded by the CAIXA Best Practices Program for Local Management (BARBOSA, 2003).

The project was divided into three stages; the first phase would cover 1,250 meters of the igarapé, between Av. Perimetral and Rua São Domingos, corresponding to a third of its route; the second phase, between Rua São Domingos and Av. Gentil Bittencourt, with an extension of 1,100 meters; the third phase, between Av. Ponte Gentil Bittencourt and Vileta, 1,000 meters long, the first phase

being executed in the early 2000s and completed in 2004 in the project project (LEÃO, 2013).

The macro-drainage work of the Tucunduba basin was resumed in 2016, after twelve paralyzed years, beginning the second stretch with changes in the initial project, disregarding the revitalization of the ciliary forest and concreting the banks of the igarapé transforming it into a canal.

According to a state government website, the works should include "the opening and paving of new runways, the construction of pedestrian walkways, bicycle paths, drainage and dredging of the canal and the construction of three concrete bridges and a metal walkway." The second stretch is scheduled to be completed in April 2019.

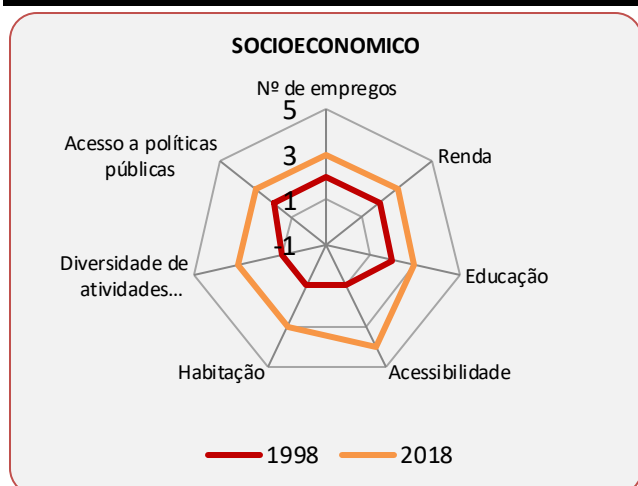
III. REGRESSIVE SOCIOECONOMIC AND ENVIRONMENTAL ANALYSIS (SEA): THE BEFORE, THE NOW AND AFTER THE MACRODRENAGE WORKS OF THE TUCUNDUBA.

With the beginning of the works many families were relocated, this process was initially intended to transfer people to places close to the intervention area with the concern of setting them in places with access to infrastructure and the continuity of their activities. However, it was difficult to find nearby areas, and the Municipality of Belém (PMB) adopted new strategies by relocating the families to outlying settlements in Tucunduba or by purchasing dwellings pointed out by the residents.

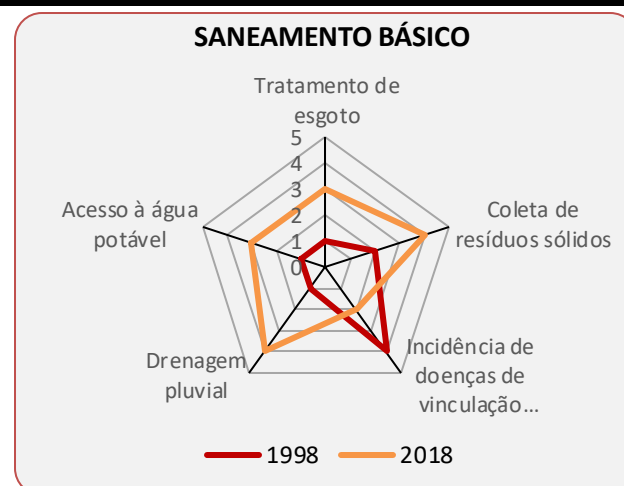
In 2001 PMB created a complementary project to the Tucunduba project, the Local Development Plan (PDL) Riacho Doce and Pantanal, communities located in the intervention area of the first phase of the macrodrainage. This PDL emerged as an attempt to correct the distortions that occurred in the Tucunduba project, especially in the disrespect for housing and living conditions of the population (LEÃO, 2013).

The Pantanal set, a research site, was built with the objective of contributing to the improvement of the quality of life of families, through land regularization actions, urban infrastructure, housing improvements, environmental education, work and income generation (BARBOSA, 2003).

It can be observed in graph 01 that the attributes evaluated in the socioeconomic dimension suffered a great variation. The index rose during the analyzed period. This growth can be attributed to the constant interventions that the area has undergone in the last 20 years. Although the works are in trouble and still leave many residents unsatisfied, the area has already had important advances, such as building a school in the neighborhood and a health post. Today, the place has trade shows and a variety of trade.



Graph 1. Socioeconomic analysis.



Graph 2. Basic sanitation.

Basic Sanitation Conditions

The basic sanitation index had a positive jump, but in a subtle way, taking into account the years since the Tucunduba Project. The treatment of sewage had an improvement considering that before the PDL the dwellings were style stilts, without a suitable bathroom, with direct eviction in the igarapé. All the Pantanal houses have septic tank, but there is no collection for a sewage treatment plant, another problem is the irregular occupation installed in the riverbank that spills untreated sewage.

The PDL RiachoDoce and Pantanal brought to the community drinking water supply, a service provided by the Companhia de Saneamento do Pará (COSANPA), which structured the entire Pantanal complex. With the long stalling of macrodrainage works, new irregular occupations were made in areas that had already been vacated with the relocation of families, which caused clandestine connections in the Pantanal's supply network interfering with water pressure and quality.

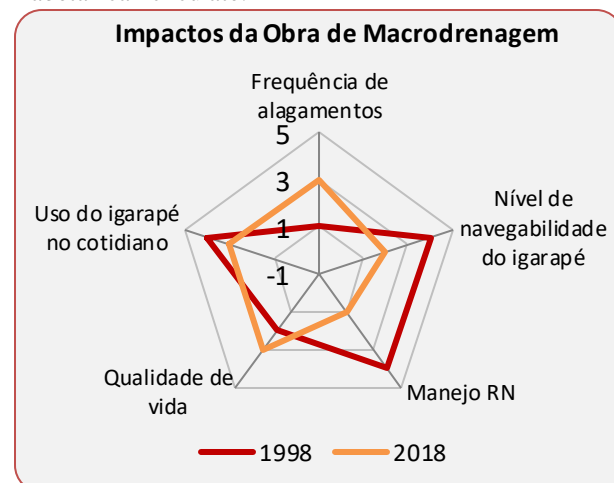
The collection of solid waste is done daily, but the community has serious problems with the irregular dumping of rubble. Despite the leadership of the group community in trying to raise public awareness, actions are isolated and of low effect.

As a result of improved sanitation conditions, the incidence of water-borne diseases has declined. According to reports from older residents, it was common for children and adults to have intestinal pain, diarrhea and even schistosomiasis, and there was no health clinic in the locality. Currently, in addition to access to drinking water, this situation has improved, residents consume mineral water and there is a medical center to serve the community. In the chart below we can see in a general way the variation of the evaluated scores.

Impacts of macrodrainage work

The first Tucunduba project planned to recover the entire riverbank, maintain its navigability and adequate conditions for community subsistence was executed only in the first stage, which competes from the voice to Rua Santo Domingos at around 1,250 meters. A part of this area is inside the UFPA and one can see a navigable stream with ciliary forest and without pollution.

With the re-evaluation of the initial project, the second stage is being carried out transforming the river into a canal, discarding the possibility of revitalization of the stream and maintenance of local community customs for subsistence use. Before the interventions, the river was wide, containing large vessels with goods circulation. Currently, the use of the river for trade and navigation is practically non-existent, only small boats known as "rabeta" can circulate.



Graph 3. Impacts of macrodrainage work.

IV. CONCLUSION

The Tucunduba Project was thought to be an innovative structural intervention associated with the socioeconomic-cultural development of the city of Belém, whose objective

was the mobilization of a globalizing productive territoriality. However, with the redesign of the project, the innovative idea of river revitalization, port implementation and a new urban river management model, which made the project nationally recognized, did not materialize.

The macro drainage of the Tucunduba Basin no longer fulfills its sustainable role from the beginning of the second stage. Being implemented only as a physical intervention, the project stops implementing actions such as participation and social control and to carry out education and environmental management control campaigns.

Given what was observed in the field and in an interview with the residents of the Pantanal complex, it can be seen that access to basic sanitation services improved considerably compared to the situation prior to the project. However, it is still not ideal, the community goes through problems of water supply and irregular dumping of solid waste. The river still has stretches with its irregularly occupied bed and untreated sewage dump, a situation that could have been avoided with the continuity of the works within the initially planned schedule.

Thus, it can be concluded from this research that the Tucunduba Project brought structural and socioeconomic advances in the accomplishment of its first stage. However, the long years of work stoppage and the restructuring of the initial project caused negative impacts on the population. The low involvement of the community in the decisions and, mainly, the lack of complementary actions of social control and environmental education causes the river to continue being occupied in an irregular and polluted way.

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